→ U.S. EPA Region V

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

Date: April 26, 1994 **File Ref:** 4500

To: File

From: Sheryl Melchert, LMD SM

Subject: Review of Stack Test Performed at Red Arrow Products, 55 071 00053

I. SOURCE

Red Arrow Products Co. Inc.
1226 South Water Street
Manitowoc, WI 54221
FID # 436036700

Process Tested: Sawdust Dryer
Stack/Process: S01/P01
Permit: 85-IRS-046A (Issued 11\17\93)
Particulate = Method 5
CO = Method 10

Test Date: 2-17-94
Test Firm: Badger Laboratories & Engineering Co.
1110 South Oneida Street
Appleton, WI 54915
Crew Chief: Bruce Lamers (414) 739-9213

II. SOURCE DESCRIPTION

The sawdust dryer at Red Arrow Products was tested for particulates to determine compliance after a failed stack test in 1992. Particulate emissions were tested at the cyclone outlet. The dryer's wood-fired burner was also tested for carbon monoxide. The dryer operated at an average throughput of 12,940 lb of wet sawdust/hr. The maximum capacity of the process is 18,000 lb of wet sawdust/hr.

A new multiclone (Fisher Klosterman, XQ170-30) was installed on the dryer in January 1994.

III. SUMMARY OF RESULTS

Table 1.

Pollutant Tested	Location	Emissions	Limit
Particulate	cyclone outlet	9.90	10.00 lb/hr *
		0.22	0.20 lb/1000lb exhaust gas
Carbon Monoxide	dryer inlet	414 646°F 2039°F	600 ppm @ 7% O_2 $T_{dryer\ inlet}$ = ≤ 800 °F $T_{comb.\ chamber}$ = ≥ 1250 °F

* The limit of 10.00 lb/hr applies because it is the more stringent of the hourly limit based on modelling and the hourly limit based on the process rate equation (E). Note that E = 3.59(6.47 tons/hr)$^{0.62}$ = 11.42 lb/hr.

ANUM 020 5/12/94

IV. DISCUSSION OF RESULTS

I checked over the results and found them to be correct except for minor errors which I corrected. The report contained calibration data for the sampling equipment and production data for the source.

The results are found in Table 1. The source is not in compliance with the applicable particulate limit even with the new cyclone. Thus, the sawdust dryer has operated in noncompliance of particulate emission rate of 0.20 lb/1000 lb of exhaust gas since June 11, 1992.

The pressure drop across the cyclone was not measured. Red Arrow has been requested to add a device to measure the pressure drop across the cyclone. The outlet air flow measured averaged 13,200 acfm at 186 °F.

The source intends to retest the sawdust dryer May 18, 1994, and intends to try and increase the cyclone collection efficiency. This will be done by increasing the pressure drop across the multicone to 17.6 inches w.c. This is equivalent to an inlet air flow of 14,000 acfm. A pressure drop of 20 inches w.c. is the maximum recommended by Fisher-Klosterman for this multiclone.

The test results indicates the dryer's burn chamber meets BACT. However, the CO test location needs to be moved upstream to the outlet of the fuel burn chamber. The present location is downstream of one of two fresh air inlet dampers. Mike Swantek told me he will relocate the sample port by the summer of 1994.

cc: Joe Perez - AM/7
USEPA Region V
Faxed to Jennifer Darrow, USEPA - 312/886-0617

BADGER LABS & ENGINEERING Est. 1966
1110 S. Oneida St., Appleton, WI 54915

Red Arrow Products Co., Inc. Particulate & CO Emission Test

I. Introduction and Summary

Badger Laboratories & Engineering Co., Inc. (BL&E) was retained by Red Arrow Products Co., Inc. to determine the concentration of Particulate emissions in the exhaust from a sawdust drying process and Carbon Monoxide emissions from the burner serving this process. The plant is located in Manitowoc, WI. A Fisher-Klosterman, Inc.; Model XQ120-26.5 cyclone collection device is used for particulate control.

Emission tests were conducted February 17, 1994 by Bruce Lamers and Craig Neveu. The purpose of the testing was to determine if the source was in compliance with applicable WDNR limitations. Mr James Crawford from the WDNR was present to witness the testing. Testing was performed following U.S. EPA Methods. Mr. Michael Swiontek is the Red Arrow Products contact.

A summary of the Particulate results are as follows:

PARTICULATE EMISSION RESULTS

Test Run	Volumetric Flow Rate scfh	Isokinetic Ratio, %	lb/hr.	Particulate Emission gr/dscf
1	0.532x10⁶	~~96.3~~ 97.7	.24	10.64	0.140
2	0.530x10⁶	96.9 97.3	.23	10.27	0.135
3	0.556x10⁶	~~95.0~~ 96.3	.19	8.78	0.110
		ave .22	ave 9.90	

The arithmetic average of the three tests is 9.90 lbs./hr. The WDNR limitation for this type of source is given as 10.00 pounds per hour and/or $E = 3.59 \times P^{0.62}$; where E = the emission rate and P = the throughput in tons/hr. The throughput during the test period averaged 6.47 tons/hour. The particulate limitation for the test period was calculated to be 11.42 lbs./hr.

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A summary of the Carbon Monoxide results are as follows:

Carbon Monoxide Results

Test Run	Volumetric Flow Rate: scfh	CO NDIR ppm	CO ppm, corrected to 7% O_2	lb/hr.
1	0.392×10^6	115.8	352.4	3.17
2	0.390×10^6	189.4	631.3	5.20
3	0.414×10^6	77.6	258.7	2.26

The arithmetic average of the results is 414 ppm corrected to 7% Oxygen. The limitation for this source is given as 600 ppm.

II. Process Description

The exhaust stack carries exhaust gases from the burner and sawdust dryer. The burner is used to generate the heat needed to dry the sawdust. The process involves the drying of hardwood sawdust in a Heil model SD-22 rotary dryer. The dried sawdust and exhaust gases are separated in a cyclone prior to the Fisher-Klosterman collector. Particulate emissions are removed by a Fisher Klosterman, Inc.; Model XQ120-26.5 cyclone collector.

The following is a summary of the Process Throughput:

Process Data

Test Run	Sawdust Dried, tons
1	7.24
2	7.01
3	5.18
ave.	6.47

III. Comments

The testing on February 17, 1994 was performed without any sampling problems that we were aware of. We believe the test results presented accurately indicate the emission rate during the test period.

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Location:	Sawdust Dryer
Date:	2-17-94
Time:	10:01-11:03
Test Run:	1

STACK GAS DATA

Temperature:	187
Velocity, ft/sec.	69.96
Gas Volume, ACFM	13187
Gas Volume, SCFM (wet)	10624
Gas Volume, SCFM (dry)	8865
Moisture, %	16.5
Carbon Dioxide, % (dry)	1.8
Oxygen, % (dry)	18.6
CO & Nitrogen, % (dry)	79.6
Molecular Weight, (wet)	27.21

SAMPLING DATA:

Total Time, min.	60
Volume, SCF (dry)	52.930
Isokinetic Ratio, %	~~96.3~~ 97.7

PARTICULATE:

Amount Collected, mg. (including condensible)	480.3
Concentration, grains/DSCF	0.140
Emission Rate, lb/hr.	10.64
Emission Rate, lb/1000 lb gas	0.24

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ADGER LABS & ENGINEERING Est. 1966
1110 S. Oneida St., Appleton, WI 54915

Location:	Sawdust Dryer
Date:	2-17-94
Time:	11:45-12:47
Test Run:	2

STACK GAS DATA

Temperature:	187
Velocity, ft/sec.	69.86
Gas Volume, ACFM	13169
Gas Volume, SCFM (wet)	10614
Gas Volume, SCFM (dry)	8827
Moisture, %	16.8
Carbon Dioxide, % (dry)	2.4
Oxygen, % (dry)	17.8
CO & Nitrogen, % (dry)	79.8
Molecular Weight, (wet)	27.23

SAMPLING DATA:

Total Time, min.	60
Volume, SCF (dry)	53.015
Isokinetic Ratio, %	~~96.9~~ 97.3

PARTICULATE:

Amount Collected, mg. (including condensible)	466.1
Concentration, grains/DSCF	0.135
Emission Rate, lb/hr.	10.27
Emission Rate, lb/1000 lb gas	0.23

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Location:	Sawdust Dryer
Date:	2-17-94
Time:	13:25-14:27
Test Run:	3

STACK GAS DATA

Temperature:	183
Velocity, ft/sec.	70.24
Gas Volume, ACFM	13239
Gas Volume, SCFM (wet)	10736
Gas Volume, SCFM (dry)	9265
Moisture, %	13.7
Carbon Dioxide, % (dry)	2.4
Oxygen, % (dry)	17.8
CO & Nitrogen, % (dry)	79.8
Molecular Weight, (wet)	27.58

SAMPLING DATA:

Total Time, min.	60
Volume, SCF (dry)	54.553
Isokinetic Ratio, %	~~95.0~~

PARTICULATE:

Amount Collected, mg. (including condensible)	390.9
Concentration, grains/DSCF	0.110
Emission Rate, lb/hr.	8.78
Emission Rate, lb/1000 lb gas	0.19

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NAME OF SOURCE: RED ARROW

LOCATION OF SOURCE: MANITOWOC

PROCESS TESTED: P01

DATE OF TEST: 021794

RUN NUMBER: 1

N NUMBER OF SAMPLING POINTS= 12

VM DGM VOL,METER COND DRY= 52.91 CFD

PB BAR PRESS,STATION= 29.55 IN HG

VL TOTAL VOL OF WATER COLLECTED= 223 ML

%CO2 % CARBON DIOXIDE BY VOL,DRY BASIS= 1.8 %

%O2 % OXYGEN BY VOL,DRY BASIS= 18.6 %

%CO % CARBON MONOXIDE BY VOL, DRY BASIS= 0 %

%N2 % NITROGEN BY VOL,DRY BASIS= 79.6 %

CP PITOT TUBE COEFFICIENT= .84

PS STACK PRESS= 29.53 IN HG

AS AREA OF THE SAMPLING SITE= 3.142 SQ FEET

MT TOTAL DRY PARTICULATE= .4803 GM

T TOTAL SAMPLING TIME= 60 MIN

AN AREA OF THE NOZZLE= .00032 SQ FEET

RED ARROW,P01,RUN: 1

CALCULATED RESULTS

TS STACK TEMPERATURE = 186.8333 DEG F

VMSTD DGM VOL,STD COND DRY= 52.93016 SCFD

VWSTD VOL OF WATER VAPOR,STD COND= 10.49661 SCF

%M % MOISTURE IN STACK GAS BY VOL,STD COND= 16.54918 %

MD MOLE FRACTION OF DRY GAS= .8345082

MWD MOLECULAR WT OF STACK GAS,DRY BASIS= 29.032 LB/LB-MOLE

MWS MOLECULAR WT OF STACK GAS,WET BASIS= 27.2063 LB/LB-MOLE

VS AVE STACK GAS VELOCITY,STACK COND= 69.95879 FPS

QACT ACTUAL STACK GAS FLOW RATE= 13188.63 CFM

QSTD AVE STACK GAS FLOW RATE,STD COND DRY= 8866.939 SCFMD

%EA AVE % EXCESS AIR= 770.3783 %

PMRA AVE PMR BY RATIO OF AREAS METHOD= 10.39694 LB/HR

PMRC AVE PMR BY CONC METHOD= 10.64317 LB/HR

PMR(AVE) AVE PMR,STD COND DRY= 10.52005 LB/HR

C EMISSION CONC,STD COND DRY= .1400152 GR/SCFD

DGR AVE STACK GAS RATE,STD COND DRY= 40056.97 LB/HR

LB/MLB EMISSION CONC,STD COND DRY= .2626272 LB/MLB OF DRY GAS

WGR AVE STACK GAS RATE,STD COND WET= 44982.13 LB/HR

LB/MLB EMISSION CONC,STD COND WET= .2338718 LB/MLB OF WET GAS

%ISR % ISOKINETIC RATIO= 97.68649 %

NAME OF SOURCE: RED ARROW

LOCATION OF SOURCE: MANITOWOC

PROCESS TESTED: P01

DATE OF TEST: 021794

RUN NUMBER: 2

N NUMBER OF SAMPLING POINTS= 12

VM DGM VOL,METER COND DRY= 53.61 CFD

PB BAR PRESS,STATION= 29.55 IN HG

VL TOTAL VOL OF WATER COLLECTED= 228 ML

%CO2 % CARBON DIOXIDE BY VOL,DRY BASIS= 2.4 %

%O2 % OXYGEN BY VOL,DRY BASIS= 17.8 %

%CO % CARBON MONOXIDE BY VOL, DRY BASIS= 0 %

%N2 % NITROGEN BY VOL,DRY BASIS= 79.8 %

CP PITOT TUBE COEFFICIENT= .84

PS STACK PRESS= 29.53 IN HG

AS AREA OF THE SAMPLING SITE= 3.142 SQ FEET

MT TOTAL DRY PARTICULATE= .4661 GM

T TOTAL SAMPLING TIME= 60 MIN

AN AREA OF THE NOZZLE= .00032 SQ FEET

RED ARROW,P01,RUN: 2

CALCULATED RESULTS

TS STACK TEMPERATURE = 186.5833 DEG F

VMSTD DGM VOL,STD COND DRY= 53.01885 SCFD

VWSTD VOL OF WATER VAPOR,STD COND= 10.73196 SCF

%M % MOISTURE IN STACK GAS BY VOL,STD COND= 16.83424 %

MD MOLE FRACTION OF DRY GAS= .8316577

MWD MOLECULAR WT OF STACK GAS,DRY BASIS= 29.096 LB/LB-MOLE

MWS MOLECULAR WT OF STACK GAS,WET BASIS= 27.22808 LB/LB-MOLE

VS AVE STACK GAS VELOCITY,STACK COND= 69.86315 FPS

QACT ACTUAL STACK GAS FLOW RATE= 13170.6 CFM

QSTD AVE STACK GAS FLOW RATE,STD COND DRY= 8827.981 SCFMD

%EA AVE % EXCESS AIR= 544.8086 %

PMRA AVE PMR BY RATIO OF AREAS METHOD= 10.08955 LB/HR

PMRC AVE PMR BY CONC METHOD= 10.26592 LB/HR

PMR(AVE) AVE PMR,STD COND DRY= 10.17774 LB/HR

C EMISSION CONC,STD COND DRY= .1356484 GR/SCFD

DGR AVE STACK GAS RATE,STD COND DRY= 39968.9 LB/HR

LB/MLB EMISSION CONC,STD COND DRY= .2546415 LB/MLB OF DRY GAS

WGR AVE STACK GAS RATE,STD COND WET= 44973.97 LB/HR

LB/MLB EMISSION CONC,STD COND WET= .2263028 LB/MLB OF WET GAS

%ISR % ISOKINETIC RATIO= 98.28196 %

NAME OF SOURCE: RED ARROW

LOCATION OF SOURCE: MANITOWOC

PROCESS TESTED: P01

DATE OF TEST: 021794

RUN NUMBER: 3

N NUMBER OF SAMPLING POINTS= 12

VM DGM VOL,METER COND DRY= 55.1 CFD

PB BAR PRESS,STATION= 29.55 IN HG

VL TOTAL VOL OF WATER COLLECTED= 184 ML

%CO2 % CARBON DIOXIDE BY VOL,DRY BASIS= 2.4 %

%O2 % OXYGEN BY VOL,DRY BASIS= 17.8 %

%CO % CARBON MONOXIDE BY VOL, DRY BASIS= 0 %

%N2 % NITROGEN BY VOL,DRY BASIS= 79.8 %

CP PITOT TUBE COEFFICIENT= .84

PS STACK PRESS= 29.52 IN HG

AS AREA OF THE SAMPLING SITE= 3.142 SQ FEET

MT TOTAL DRY PARTICULATE= .3909 GM

T TOTAL SAMPLING TIME= 60 MIN

AN AREA OF THE NOZZLE= .00032 SQ FEET

RED ARROW,P01,RUN: 3

CALCULATED RESULTS

TS STACK TEMPERATURE = 182.5 DEG F

VMSTD DGM VOL,STD COND DRY= 54.54836 SCFD

VWSTD VOL OF WATER VAPOR,STD COND= 8.66088 SCF

%M % MOISTURE IN STACK GAS BY VOL,STD COND= 13.70192 %

MD MOLE FRACTION OF DRY GAS= .8629808

MWD MOLECULAR WT OF STACK GAS,DRY BASIS= 29.096 LB/LB-MOLE

MWS MOLECULAR WT OF STACK GAS,WET BASIS= 27.57563 LB/LB-MOLE

VS AVE STACK GAS VELOCITY,STACK COND= 70.24174 FPS

QACT ACTUAL STACK GAS FLOW RATE= 13241.97 CFM

QSTD AVE STACK GAS FLOW RATE,STD COND DRY= 9265.511 SCFMD

%EA AVE % EXCESS AIR= 544.8086 %

PMRA AVE PMR BY RATIO OF AREAS METHOD= 8.461716 LB/HR

PMRC AVE PMR BY CONC METHOD= 8.782964 LB/HR

PMR(AVE) AVE PMR,STD COND DRY= 8.622339 LB/HR

C EMISSION CONC,STD COND DRY= .1105732 GR/SCFD

DGR AVE STACK GAS RATE,STD COND DRY= 41949.82 LB/HR

LB/MLB EMISSION CONC,STD COND DRY= .2055393 LB/MLB OF DRY GAS

WGR AVE STACK GAS RATE,STD COND WET= 46070.32 LB/HR

LB/MLB EMISSION CONC,STD COND WET= .1871561 LB/MLB OF WET GAS

%ISR % ISOKINETIC RATIO= 96.34238 %

2-17-94 — Airco — 1420 ppm — FF-8833

Burner — Airco — 469 ppm — FF-7301

Red Arrow — Airco

Run #1			Run #2		Run #3	
10:00	8.5		11:45	10.5	1:25	9.0
02	10		47	9.0	27	4.5
04	9.5		49	9.5	29	5.5
06	8.0		51	9.0	31	5.5
08	7.5		53	8.5	33	7.0
10	8.0		55	9.0	35	6.5
12	8.0	122	57	8.5	37	7.0
14	9.0	135	59	11.5	39	6.0
16	8.5	128	12:01	13.0	41	6.0
18	8.0		03	11.0	43	5.5
20	12		05	9.5	45	5.5
22	10		07	9.0	47	4.5
24	9.5		09	11.5	49	4.5
26	7.0		11	16.0	51	4.5
28	6.5		13	15.5	53	4.5
30	6.5		15	13.0	55	6.0
32	7.0		17	11.5	57	5.5
34	6.0		19	15	59	5.0
36	6.0		21	14.0	2:01	5.0
38	5.5		23	13.0	03	4.5
40	5.0		25	11.5	05	4.0
42	6.0		27	10.5	07	4.0
44	8.5		29	11.0	09	4.0
46	8.0		31	12.0	11	4.0
48	6.5		33	14.5	13	4.0
50	7.0		35	15.0	15	5.0
52	8.0		37	15.5	17	5.0
54	7.0		39	16.0	19	5.5
56	6.5		41	16.5	21	4.4
58	7.5		43	17.5	23	4.0
11:00	8.5		45	24.0	25	4.4

Run #1: 239.5 ÷ 31 = 7.72; X15ppm = (115.8)

Run #2: 391.5 ÷ 31 = 12.63; X15ppm = (189.4)

Run #3: 160.3 ÷ 31 = 5.17; X15ppm = (77.6ppm)

32" Ø duct

cal gas before 1420 = 94.7; 469 = 31.7; zero nitrogen = 0.0

after 469 = 31.7; zero N_2 = 0.2

after 469 = 31.6; zero N_2 = 0.0

after 1420 = 94.3; 469 = 31.7; zero N_2 = 0.0